

Potential Bio-Effects in Human Health from Radio Frequency Smog

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(Received: 06 October 2015; accepted: 18 November 2015)

In the modern era, communication technologies had a significant development. Thus, in order to improve the capacity and coverage, a massive technological advancement has become widespread subject. However, the pollution caused by the Radio Frequency Electromagnetic Field (RF-EMF) radiation is considered as the greatest environmental hazard. Hence, the present review proposes a suitable solution to mitigate the RF pollution or smog from base station installation in hot spot areas. Some reports indicated the harmful effects of health caused by base station that discharge the maximum value of electro-magnetic radiation nearer to the residential area. Due to secure the people who are living around the base stations and low message transfer between cellular communication between users, BS and the core network to access internet. Low power, confining radiation pattern, distance factor and signal transmission are factors reducing base stations that leads to considerably decrease the Radio Frequency pollution and interference reduction. The aim of this paper to explore limit for RF field interference in the Small Cell Base Station (SCBS). As well as a standard limitation is provided in the RF interference range.

Key words: Human health problem, Bio-effects, Radio Frequency, Electromagnetic Field, reduction.

In India long term exposure due to base-station Radio Frequency Electromagnetic Field (RF-EMF) radiation has been recognized as serious health concern. Research efforts have increased in response to public complaints and in view of the World Health Organization's (WHO) recommendation, the government has announced limitation of frequencies against the base-station installation. Numerous solutions have been given for meeting heterogeneous wireless communication demand. This review discusses the adverse effects of RF-EMF interference Small Cell Base-Stations (SCBS) in hot spot areas in view of biological effects of human health exposure.

The SCBS are established above the ground level and nearby the mobile phone

subscribers. Mobile networks are mainly designed to utilize the shortest feasible power from base stations. Therefore, these networks automatically regulate the transmitter power in the base station based on the users distance. The optimal network design is carried out based on the locations of the base stations and users of mobile phone. If the base-stations are situated nearer to the user, then it would produce the low level of EMF, while far away from user, it produces high level EMF. Similarly, when the base stations are situated nearer to the mobile phone users, the transmitter power required by the mobile phone is low and EMF [1] production is relatively low. If base stations are situated far away from the user, then the power required is generally higher, and produces higher EMF [2]. Hence, nearer the base station, lower the EMF and good reception. Several previous studies conducted earlier reported that base stations works at lower power that leads to low interference of RF

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pollution. Further, the EMF level also low in the base stations which is similar to broadcast television and radio

This paper mainly reviews the evaluation of interference of Radio Frequency (RF) from mobiles base stations and their adverse effect of humans. RF fields emitted by base stations are results severe health problem. Various studies [3] [4] [5] have identified that these RF fields cause carcinogenic to humans. Even though various studies have stated the adverse effect, there is no previous evidence of environmental exposure to RF fields comes from base stations may enhance the cancer risk or any other risk. The radio frequency affected the normal biological cells of the individual by inducing the electromagnetic effects at increase in temperature. These effects are attributed to the induced electromagnetic inside the biological cells of the body which is possibly more harmful. Individuals who are living nearer to the base station or frequently exposed to the emissions of low level wireless antenna have felt various severe symptoms at the time and after its use such as fatigue, dizziness, ringing in the ears, headache, heart palpitation, tingling sensation in the skin of the head, burning, loss of memory, sleep disturbance, lack of concentration, reaction time and disturbance in the digestive system etc. The interference of base station EMW and some medical devices are reducing the risk in newer design of small cell coverage. Since the cellular base stations are successfully extenuating RF signal interference through thoughtful radio system knowledge with proper cell planning, frequency and bandwidth allocation. Thus the heterogeneity in the wireless communication a new technology development of the small cell base station was introduced.

Radiation effects and EMF emissions

Generally, radiation is exhibited by both man-made and natural radiation and they are electromagnetic in nature. In general, there are two categories of electromagnetic radiation which includes the ionizing and non-ionizing radiation. From the research it is evident that the ionizing radiation has a capability to eradicate the electron which is from the atom's orbit of an atom, where it becomes an ionized atom to cause health hazard [8]. For instance, X-rays are perceived as ionized material due to high [22] [26] [27] EMF frequency.

However, in the case of non-ionizing radiation it lacks sufficient energy to ionize the atoms. Some of the non-ionizing radiations are microwave radiation [28] [29] [30] visible light and radio wave frequency (RF) energy.

In the current technological world, the society depends on mobile phones for communications purpose at work, school and home. These mobile phones generate the electromagnetic waves like X-ray and visible light. However, the range of electromagnetic radiation falls between non-ionizing and ionizing ranges of frequency, especially for mobile communication can be in the range of 450-2200 MHz but energy is directly proportional to the wave frequency.

Due to absorption of energy, RF fields ranged from at a lower level of 10 GHz to 1 MHz exposed into tissues and give heating. The penetration depth based on the frequency of the field and is greater for lower frequencies. Specific Absorption Rate (SAR) is the quantity used to measure the absorption of RF energy [10] [6] within a given tissue mass and it is expressed in units of watts per kilogram (W/kg or mW/Kg.) The quantity of RF fields between about 1 MHz and 10 GHz is measured using SAR. People who are exposed to RF fields in the SAR at 4 W/kg, produces several adverse health effects. Similarly, the range at 10 GHz of RF fields are absorbed at the surface of the skin, only few energy enter into the deepen tissues, while the above 10 GHz of RF fields exposed at power densities over 1000 W/m² produces severe health effects like skin burns and eye cataracts.

Potential Bio-effects of Exposure to Microwave/ RF Radiation

It deals with the biological entities [7]-[9] and electromagnetic fields. In the human body, more number of molecules weakly interacts with low frequency bands or EMF in the Radio Frequency (RF). One such interaction is energy absorption from the fields that may cause tissue to high degree of temperature; many intense fields will give higher heating that leads to several biological effects ranging from muscle relaxation (as produced by a diathermy device) to burns. There is a difficulty to prove the electromagnetism direct effects on human health and reported life-threatening interferences from EMF are limited to medical devices such as electronic implants, pacemakers and others.

Generally more biological effects of exposure to RF/microwave radiation are related to heating of tissues which is commonly referred as “thermal effects”, mainly due to the RF energy ability to heat biological tissue [11]-[14]. However, the evidence of harmful biological effects is unproven. Non-thermal effects have been proved in animals such as teratogenesis, carcinogenesis etc. but not tested on humans. Some of the biological effects are tested in humans are burns from contact with spectacles, metal implants RF (induction) burns, formation of Cataract (from eye exposure).

The role of long-term revelation to high radio frequency radiation [15] - [17] emitted either from mobile phones or from base stations and its relations with human’s hormone profiles. This radiation effects on pituitary–adrenal axis represented in the reduction of ACTH, cortisol, thyroid hormones, prolactin in young females, and testosterone levels.

Pulsed microwave radiation [18]- [20] used in base station of cellular device can non-thermally affect these various biological (electrical) activities and provoke adverse health reactions. Weak radiation can entail only correspondingly weak effects, and vice versa. Even though the non-thermal electromagnetic compatibility between energized electronic equipment used in hospitals and aircraft can be accepted, the human can’t accept these radiations. To be more specific it was identified that these radiations cause adverse effect to human brain functioning, especially these affect the electro-chemistry and electrical activities in human body, degrades the immune system and other health reactions [21- [24]. Moreover, these effects were experience by extensive mobile phones user and other who are subjected to long-term radiation exposure from BS.

Furthermore, the studies have identified that [25- [27] that these microwave radiation cause a serious damage to hippocampus region of the brain which results in memory loss related issues and some children had neural problems like epileptic seizures. However, the future study’s findings failed to address these issues who adopted the ability of a visible light (such as a stroboscope) flashing technique. In this technique targeted the photosensitive human sampled where every 15-20

times per second the light was flashed which provoked the seizures in the five percentage minimum of epileptics.

Evidence from both animal and human studies on association between exposure and outcome seems to be insufficient and inconsistent [3] This is perhaps due to the methodological challenge involved in distinguishing between exposed RF field from base station and characterize the high and low RF signals in the environment [4]. Despite the fact that few studies of EMF research have identified changes in behavior, cognition and brain wave patterns after exposure to RF fields produced by mobile phones. However, there is lack of convincing evidence about cardiovascular function or altered sleep pattern. Few individuals have felt the non-specific symptoms during the exposure to RF fields produced from EMF devices, and base stations. According to WHO [11] fact sheet report “Electromagnetic Hypersensitivity”, the EMF does not cause any symptoms. .In spite of that, there is a necessary to understand the individual’s difficulty from these symptoms. Overall, there is no convincing evidence associated with RF signals from base station produced adverse health effects. Since wireless networks generally give lower RF signals in comparison with base stations, so that there is no adverse health effects were observed.

Base Station mitigation effects on RF

The following are the factors that affect RF interference.

Signal Transmission

During the telephonic communication, the signals from the user’s equipment and base station are sent back and forth. The base stations produced by the RF waves are given off into the environment, where people are being exposed to them.

Mounting of the Antenna

For various reasons, the individuals are exposed to radio waves from cell phone tower antennas. Some of the reasons are the signals are intermittently transmitted not constantly, the mounted antennas are generally high above the ground level and the power levels are comparatively low.

Distance Factor

A person who is highly exposed to RF levels in nearby cell phone tower. If the cellular

antenna is fixed on a roof, it is feasible that the individual who are exposed to RF levels is higher than the ground level.

Reducing exposure level of radiation

Based on the building construction materials, the RF energy level is lower in inside the buildings than the outside. Materials like cement block or wood decreases the RF radiation exposure level by about 10 factors.

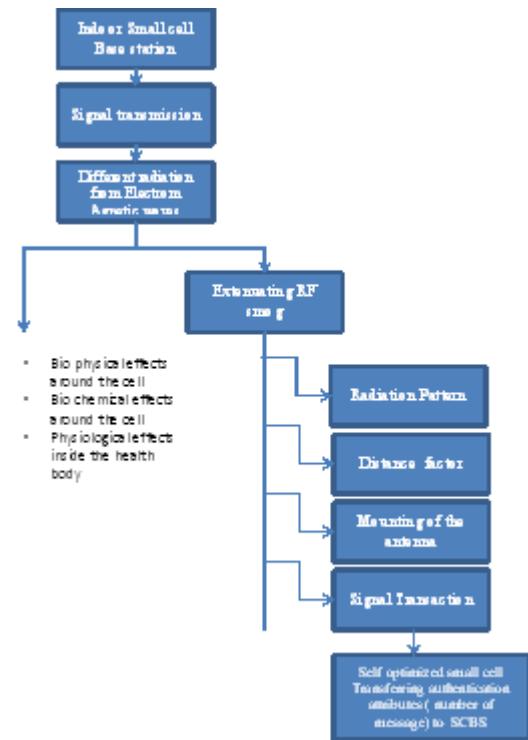


Fig.1. Reduction of RF impact from signal transmission

Antenna Radiation pattern

The radiation pattern is identified to be hundred to thousand times very low when placed in behind than in front. Hence, if the antenna is placed on the behind the building the exposure is identified to have less radiation.

Energy distribution – Base Station

The network operators have turned out to concentrate more on SCBS, due to the following reasons:

1. Good energy resource, for the growth of wireless communication.
2. This energy consumption of base-stations will give different opportunities for future heterogeneous networks.
3. Radio equipment dominated the energy consumption of a SCBS.

Hence, to reduce the energy consumption

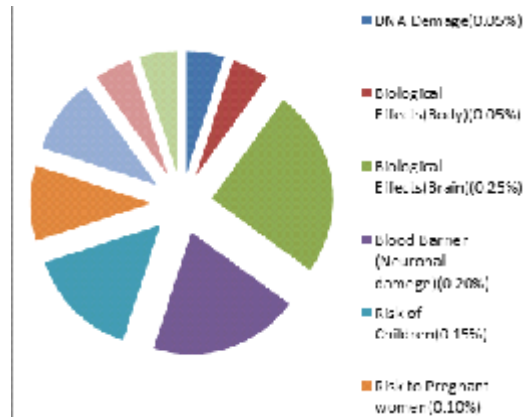


Fig. 2. Human Health Hazard from RF interference

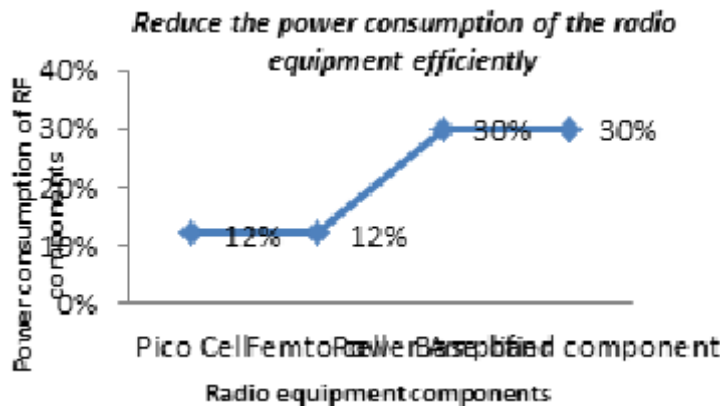
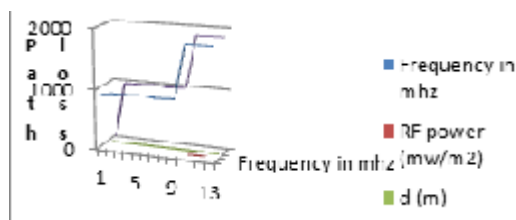


Fig. 3. Reduction of Radio equipment efficiency

Table 1. Path Loss Vs Distance

Freq. in mhz	RF power (mw/m2)	d (m)	Path loss	d (m)	path loss
939	0.003	1	971.453	5	1008.903
940	0.336	1.5	972.786	5.5	1010.736
941	0.007	1.75	973.457	6	1011.907
954	0.001	2	986.451	6.5	1025.401
955	0.119	2.25	987.569	7	1027.019
935	0.398	2.6	967.848	7.5	1007.798
943	0.002	2.9	975.452	8	1015.902
951	0.129	3.2	983.579	8.5	1024.529
1825	0.001	3.5	1857.451	9	1898.901
1827	0.687	3.8	1860.137	9.5	1902.087
1828	0.014	4.1	1860.464	10	1902.914
1830	0.3	4.4	1862.75	10.5	1905.7

**Fig. 4.** Path Loss calculation with distance

of the radio equipment efficiently, it is essential to quantify the energy consumption over the different radio equipment components and to focus on the main consumers.

Energy adaptation opportunities

Normally, base-stations are designed for maximal traffic load and high variations in the power saving parameter. To evaluate the performance of utilizing base station traffic load many parameters were adopted. From the figure, it is illustrated that the variation of BS depends on various aspects like heavy traffic period, medium traffic, heterogeneous interference period and sleep mode period.

Path Loss

Transmission power of base station depends on the strength of a RF field and signal power transmission. Multiple channels with number of channels are existed in base station. The signal transmission will also affect by direction of signal transmission, power and frequency of transmission.

CONCLUSION

The is to concentrate on the human health hazards from radio frequency interference aspects of deploying small cell base station heterogeneous networks. In addition, networks are highly utilizing base stations and small cells situated indoors or below. Several health hazard risks are observed in humans with body-mounted medical electronic devices, implanted defibrillators, or heart pacemakers when they are close and in the main beam of an operating base station antenna. It is assumed that the proposed would reduce the signal transmission; thereby the radio frequency exposure between base station and server is reduced significantly. However, future studies need to be conducted to prove this empirically.

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